SKYLAB
Simplify The Complexity

Orion Analyzer
User Manual Ver. 0.4

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CHANGE HISTORY

Date	Rev	Author	Status	Description of changes
2005-06-17	0.1	ROK	Draft	Initial document version
2005-10-14	0.2	ROK	Draft	Snapshots were updated
2005-11-11	0.3	ROK	Draft	Redesigned
2005-11-21	0.4	ROK	Draft	Redesigned after review

REFERENCES

1. Orion User Manual
2. UBP Protocol Specification (For SDK customers)
3. NMEA 0183 Standard For Interfacing Marine Electronic Devices

ABBREVIATIONS

Acronym	Description
GPS	Global Positioning System (the US military refers to it as NAVSTAR GPS) is a satellite navigation system used for determining precise location and providing a highly accurate time reference almost anywhere on Earth or in Earth orbit. It uses an intermediate circular orbit (ICO) satellite constellation of at least 24 satellites.
UBP	u-Nav Microelectronics Binary Protocol
NMEA	A combined electrical and data specification for communication between marine electronics and also, more generally, GPS receivers. The protocol is a means by which marine instruments and also most GPS receivers can communicate with each other. It has been defined by, and is controlled by the US based National Marine Electronics Association.
ASCII	American Standard Code for Information Interchange (ASCII) is a character set and a character encoding based on the Roman alphabet as used in modern English. ASCII codes represent text in computers, in other communications equipment, and in control devices that work with text. Most recent character encoding has an ASCII-like base.
XML	The Extensible Markup Language (XML) is a W3C-recommended general-purpose markup language for creating special-purpose markup languages, capable of describing many different kinds of data. Its primary purpose is to facilitate the sharing of data across different systems, particularly systems connected via the Internet.
GPS receiver	Electronic equipment that passively receives GPS signal for processing. A receiver may be hand-held or permanently mounted on a vehicle.
u-Nav Orion receiver	Standard GPS receiver which produces NMEA and UBP data
PC	Personal Computer

RS-232	A standard for serial binary data interconnection between a DTE (Data Terminal Equipment) and a DCE (Data Communication Equipment). It is commonly used in computer serial ports. A similar ITU-T standard is V.24.
COM	An interface on a computer system with which information is transferred in or out one bit at a time. Throughout most of the history of personal computers, this was accomplished using the RS-232 standard over simple cables connecting the computer to a device such as a terminal, modem or GPS receiver.
DLL	Dynamically Linkable Library. Used in Windows operating systems for shared / common / separated code to be loaded and linked to the main program at the run time.
Plug-In	Plug-in is a computer program that can, or must, interact with another program to provide a certain, usually very specific, function. In Orion Analyzer it means DLL file, where has been implemented part of Orion Analyzer functionality.
Baud	In telecommunications and electronics, baud is a measure of the "signaling rate" which is the number of changes to the transmission media per second in a modulated signal. For example: 250 baud means that 250 signals are transmitted in one second. If each signal carries 4 bits of information then in each second 1000 bits are transmitted. This is abbreviated as 1000 bit/s.

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1 ORION ANALYZER OVERVIEW

Orion Analyzer is a Windows® application which is used to connect GPS receiver via RS-232 connection for visualizing and analyzing the received data.

Orion Analyzer supports unrestricted amount of GPS receivers simultaneously. GPS receiver can be third-party manufactured receiver or u-Nav Microelectronics GPS receiver (uNav Orion receiver).

u-Nav Orion receiver produces NMEA messages and can also produce u-Nav proprietary binary protocol (UBP [2]) messages.

UBP message format features more detailed information useful in analyzing GPS navigation results. Orion Analyzer can be configured for both of these protocols from the all receivers.

NMEA protocol [3] contains only navigation data but when investigating navigation behavior, u-Nav recommends using UBP. This protocol includes everything available with NMEA plus additional proprietary information unique to the u-Nav Orion receiver which can be observed and analyzed. For more information of UBP, please take a look at UBP Protocol Specification document [2].

One of the exciting Orion Analyzer features is that all the received messages can be recorded to log files for later play back operation and analyzing.

To install Orion Analyzer, we recommend:

- Computer with a 600 MHz or faster processor

Orion Analyzer can be installed on the following operating systems:

- Microsoft® Windows® 2000 with Service Pack 4
- Microsoft® Windows® XP with Service Pack 2
- 192 MB of RAM or more
- 50 Mb of available hard-disk space
- 1024x768 or higher-resolution display with minimum 256 colors
- Keyboard and Microsoft Mouse or compatible pointing device

The program consists of several binary files (one main EXE and several plug-in DLL files for extensible functionalities). When the program is executed, it checks for all plug-in DLL files (later called Plug-In) and loads compatible ones. Those plug-in files implement different functionalities to receive or analyze the data in human readable form.

1.1 Features

The main Orion Analyzer features are:

- Unlimited amount of GPS receivers that Orion Analyzer can work on simultaneously
- Lots of different Plug-Ins for visualizing data
- Recording and playing back data operations with different formats
- Managing and controling GPS and u-Nav Orion receivers through NMEA and UBP commands
- Uploading new Orion binary to the u-Nav Orion receiver
- Ability to create, load and work with different work settings

1.2 Introduction

This user manual applies to the following software version:

- Orion Analyzer version 2.0

1.3 Content of the Orion Analyzer Package

Orion Analyzer package contains:

- Orion Analyzer version 2.0

1.4 Software and Hardware Environment

Note: Before starting the use the Orion Analyzer with your GPS receiver, please read the User Manual of the receiver, how to set it up and connect it to the host running the Orion Analyzer application.

Orion Analyzer application is compatible with Microsoft Windows® 2000 operation system and Microsoft Windows® XP.

The PC should have two serial ports (or at least one serial port) for interaction with the receiver:

- By default COM port 1 is used for NMEA protocol (baud rate 4800)
- By default COM port 2 is used for UBP protocol (baud rate 115200)

1.5 Installing the Software

Orion User Manual document [1] has the installing instructions to get the tool to your computer. The Orion binary file can be uploaded to the u-Nav Orion receiver as soon as the tool has been set up correctly.

1.6 Uninstalling the Software

Orion User Manual document [1] contains further instruction to uninstall the package.

2 ORION ANALYZER ARCHITECTURE OVERVIEW

The basic module division consists of the main program (Orion Analyzer executable file) and Plug-In libraries (DLL files). Plug-In libraries are located in PlugIns subdirectory. During the start-up time Orion Analyzer searches for PlugIns and automatically loads them.

Plug-In library consists of two major entities: the Receiver Plug-In and the Viewer Plug-In (Viewer). They may have several instances and several different types of those entities. For example a “Serial Communication Port” Plug-In implements functionality for reading and writing data from the serial port. The data is interpreted according to correct protocol form and ready messages are sent ahead to the Viewer Plug-Ins. Each Viewer Plug-In receives messages and visualizes them.

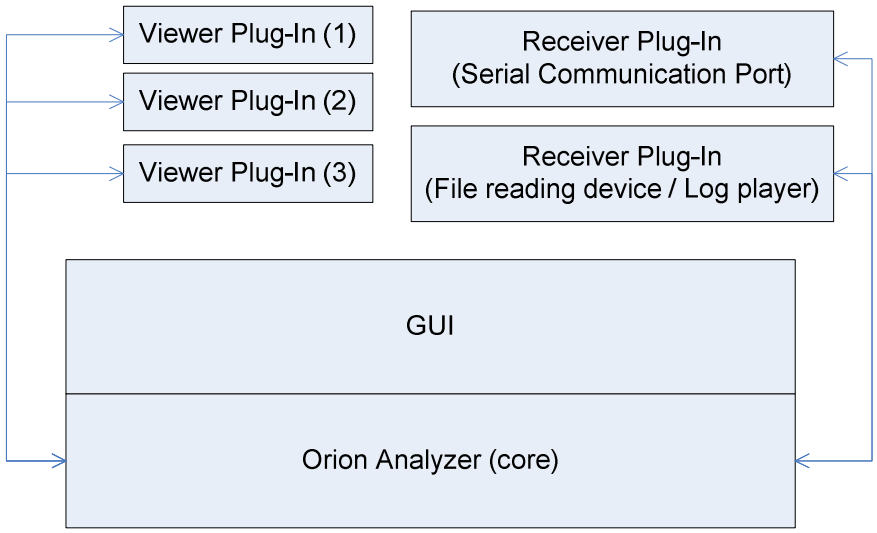


Figure 2-1. Orion Analyzer architecture overview

2.1 Protocols

Orion Analyzer supports NMEA [3] and the u-Nav proprietary protocol [2].

UBP message format contains more detailed information about u-Nav Orion Receiver and GPS navigation and it is very useful for analyzing.

Orion Analyzer can be configured for both of these protocols.

When u-Nav Orion Receiver is used as standard GPS receiver and navigation behavior is investigated, u-Nav Microelectronics recommends using UBP protocol instead of NMEA protocol. UBP includes everything available with NMEA plus additional proprietary information unique to the u-Nav Orion receiver which can be observed and analyzed using Orion Analyzer. The examples here focus on UBP, but are applicable to NMEA as well.

2.2 Receiver Plug-In logic

The new Receiver Plug-In instance is created when the user opens a new connection. There are two different connection types available:

- Serial Communication Port
- File reading device / Log player

Receiver Plug-In supports two types of protocol:

- NMEA protocol
- UBP protocol

Orion Analyzer core creates new output console window (for more details, see section 4) for each instance of the Receiver Plug-In. The receiver sends all received messages to the core of Orion Analyzer at run time. The core forwards the messages to the suitable Viewer Plug-In instances and to the console.

Each instance of Viewer Plug-In receives the messages. Basically it depends a lot on the nature of the Viewer Plug-In: some may keep messages as a history queue, some may discard message immediately after having read its content.

The Receiver Plug-In works this way until the user disconnects it. All allocated resources including the created connection instance are freed and registered Viewers Plug-In are notified about disconnection.

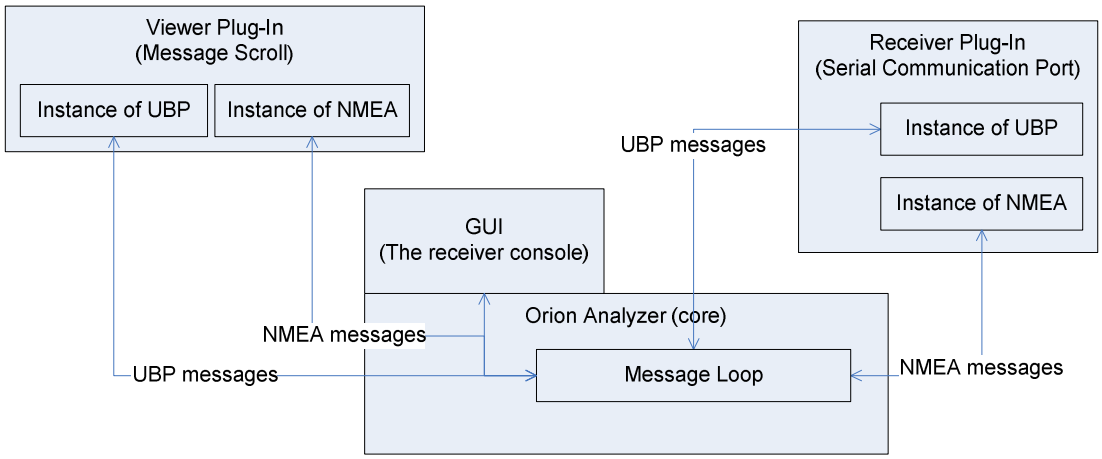


Figure 2-2. Receiver Plug-In logic

2.3 Viewer Plug-In Logic

The Viewer Plug-In instance is created when the user wants to open a new view to look and analyze the received data.

The Viewer Plug-In understands two different types of messages:

- NMEA messages
- UBP messages

Basically, the Viewer Plug-In instance just waits for incoming messages. When a message appears from the Receiver Plug-In instance, it is forwarded to the Viewer Plug-In instance. The Viewer Plug-In functionality calculates the needed steps and renders the results to the window for user viewing.

The Viewer Plug-In works by receiving messages and drawing data to the screen until the user closes it. On the close all allocated resources are freed and the message receiving connections to the Receiver Plug-In instance are disconnected.

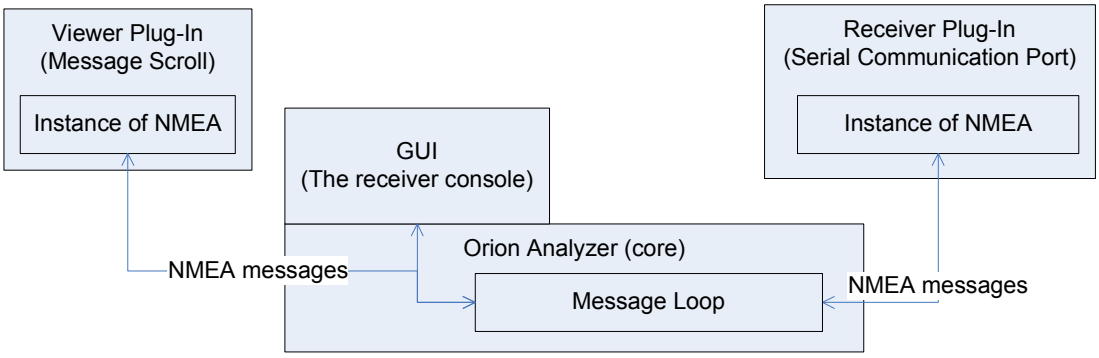


Figure 2-3. Viewer Plug-In Logic

2.4 Data Record Logic

When the Receiver Plug-In instance is established, the user may start to record the received data. In this case several recording instances can be created for one receiver object (e.g. one per each type of recording) and they are attached to the appropriate Receiver Plug-In instance.

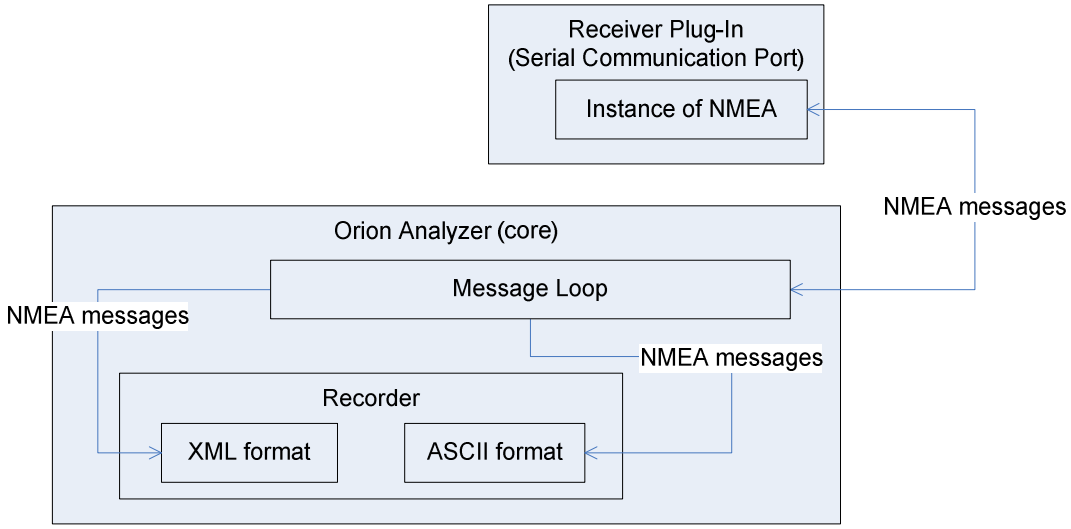


Figure 2-4. Record Operation

For different types of connections, different recording types are available:

- Receiver Plug-In connection with NMEA protocol supports:
    - ASCII recording format – each message is stored as one line in the text file

  - XML recording format – each message is saved as XML nodes with formatting

- Receiver Plug-In connection with UBP protocol supports:
  - Binary format - different types of messages are stored in different binary files. The main record file (index) keeps references to other files
  - XML format - each message is saved in text format as XML nodes

2.5 Work Settings Logic

Orion Analyzer supports saving and loading work settings. All Viewer Plug-In instances, window positions and current connections are saved in the file settings. Later the setting file can be loaded and work environment will be restored.

Note: Only one exception, the current setting, will not be saved and default work setting will be restored next time if “File reading device / Log player” is used.

3 QUICK START

To start the Orion Analyzer application, double click the Orion Analyzer application shortcut on the desktop.

3.1 First Start

When starting the Orion Analyzer for the first time, the main window with opened default session will be seen.

Next time Orion Analyzer will open the latest working session.

The default session opens serial port 1 for receiving NMEA messages from the Receiver Plug-In.

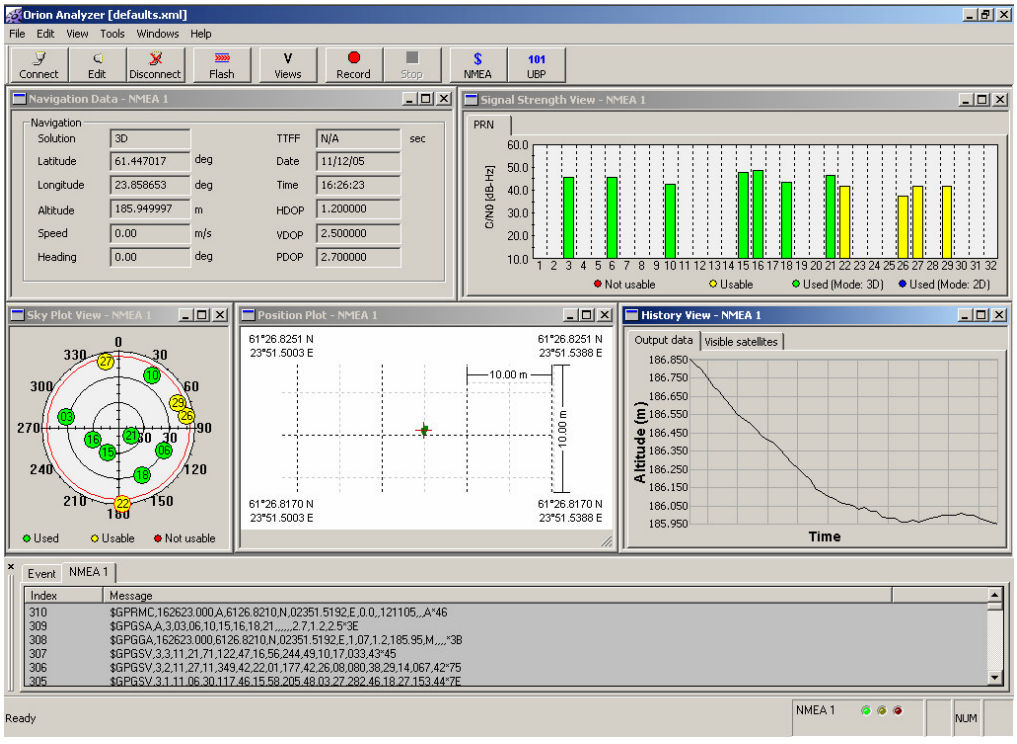


Figure 3-1. Default Orion Analyzer Session

Serial port COM1 should be used.

Go to File menu and select “Edit Connection” item. “Edit Connection” dialog can also be opened by pressing CTRL-E, or clicking on the

icon in the tool bar.

On the “Edit Connection” also port number or baud rate can be changed.

4 ORION ANALYZER GRAPHICAL USER INTERFACE

4.1 Main Window

The main GUI of Orion Analyzer has been divided in to five areas: the main menu, the toolbar, the client area, the output console and the status bar. The toolbar, output console and status bar can be disabled from the menu to get more room for the client area (area for viewer windows).

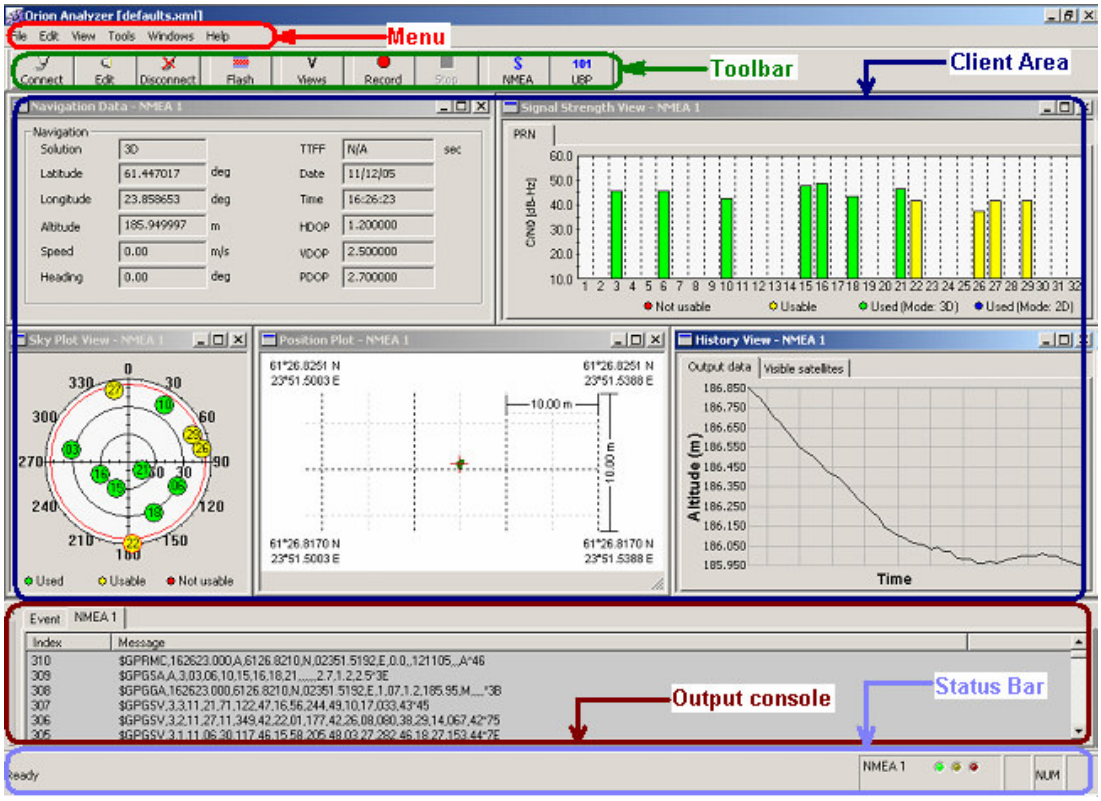


Figure 4-1. Main Orion Analyzer Window Areas

The main GUI offers a possibility to print a snapshot of the main window. The print is fitted on a paper so that the print uses the whole paper area in one dimension. The user may choose printer and fitting from the print setup. The printed area is the client area of the main window. It is also possible to get a rough preview of the print using print preview command.

4.2 System Output Console

The system output console is a docking tab control for the system information. The basic tab page is “output”, which shows basic information from the system at run time, for example errors and events. Each Receiver Plug-In instance adds at least one window to it (like navigation console below for NMEA connection).

Other windows are Receiver Plug-In related tab pages. The view shows the basic information of messages independent of the protocol. A new tab page is added for each Receiver Plug-In instance.

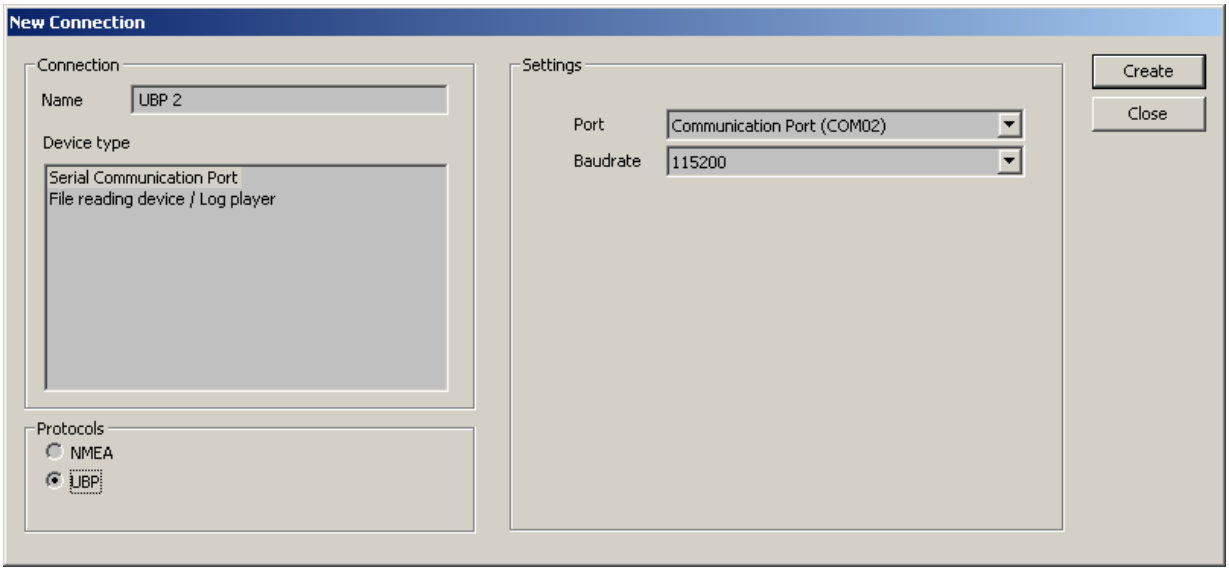
For example, NMEA connection shows original NMEA messages.

4.3 File Menu

4.3.1 New Connection…

A “New Connection” dialog can be opened by pressing CTRL-N or clicking the

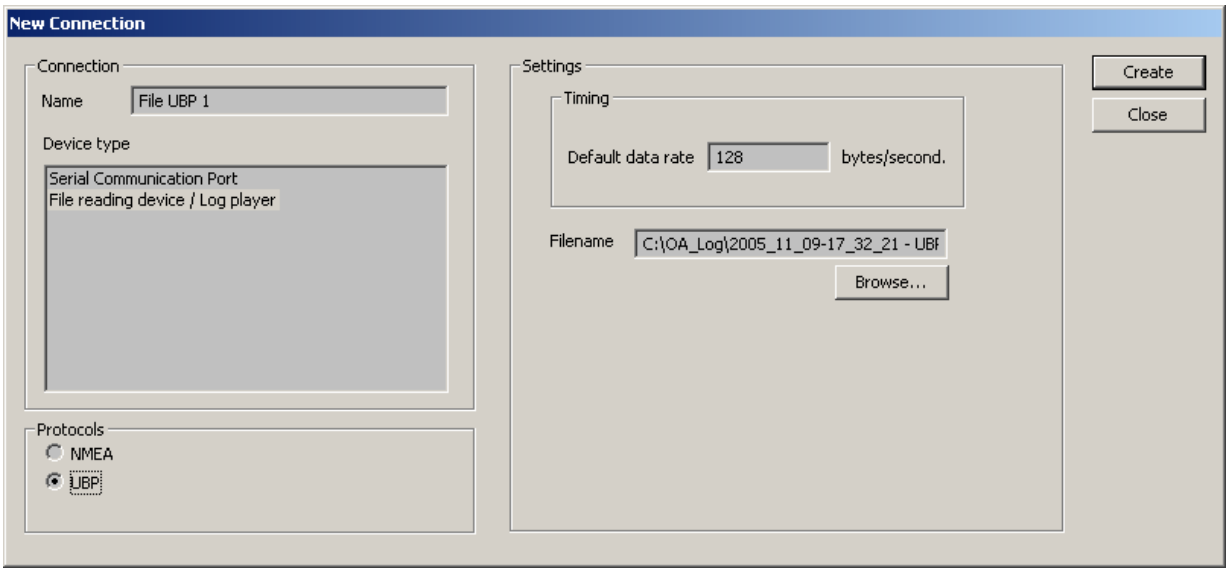
icon in the tool bar.



The basic device type is COM device, which is connected to any RS-232 communication port in the computer.

Please select the appropriate protocol type, RS-232 port and baud rate and after that click Create button. The new Receiver Plug-In instance will be created.

"File reading device" Plug-In is used for play back mode and to feed data of the recorded data file to the Orion Analyzer. In principle it works in the same way as "Serial Communication Port" Plug-In, but the data is read from a file instead of a real communication connection.



"File reading device" Plug-In can use only log files which are created by recording operation (see section: 4.4.7).

Be sure to set the Protocol radio button (NMEA or UBP) to match the log file. Browse to the subdirectory of the log session and select the Index file (for example: C:\OA_Log\2005_11_09-17_32_21 - UBP 2 (Protocol - UBP)(Type - Binary)\Binary000000.index).

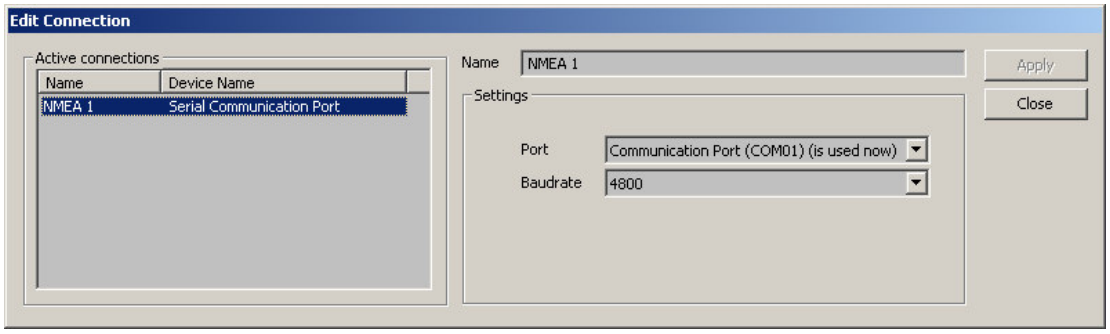
Note: It is important to select the correct protocol and index file. Incorrect settings may appear to be OK in playback, but no data will be displayed.

Note: Also "File reading device" dialog contains "default data rate" option which should not be used.

4.3.2 Edit Connection…

"Edit Connection" dialog can also be opened by pressing CTRL-E or clicking on the

icon in the tool bar.



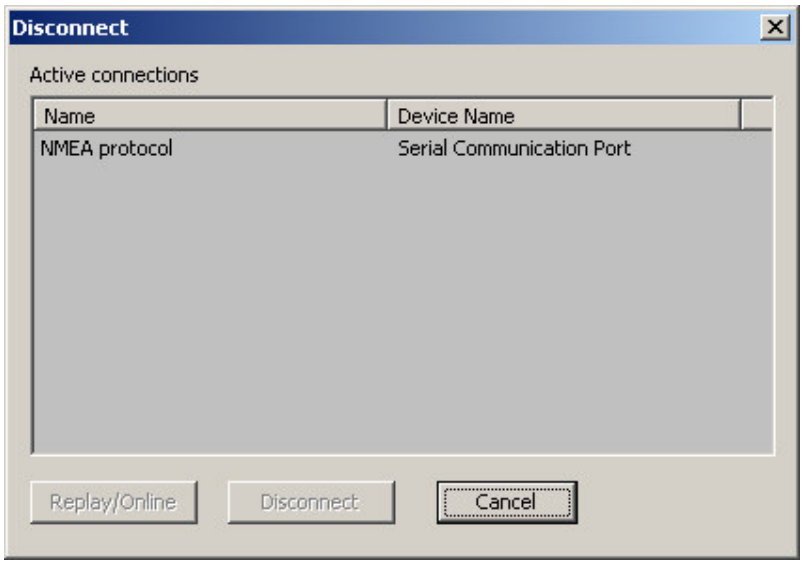
"Edit connection" dialog is used if the port or baud rate need to be changed during runtime.

For play back mode also the log file name can be changed.

4.3.3 Disconnect…

"Disconnect" dialog can also be opened by pressing CTRL-D or clicking on the

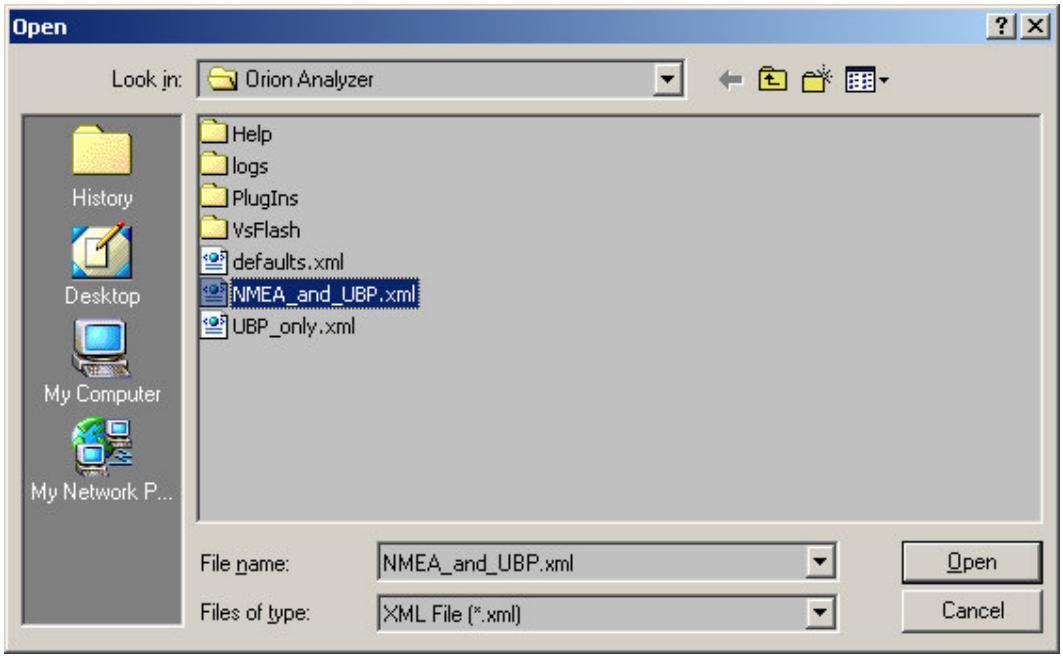
icon in the tool bar.



"Disconnect" dialog is used for closing the active connection. Select the connection to be disconnected. This will free up the associated communication port for use in a different configuration, such as logging UBP.

4.3.4 Open Settings…

"Open Settings" dialog can also be opened by pressing CTRL-O.



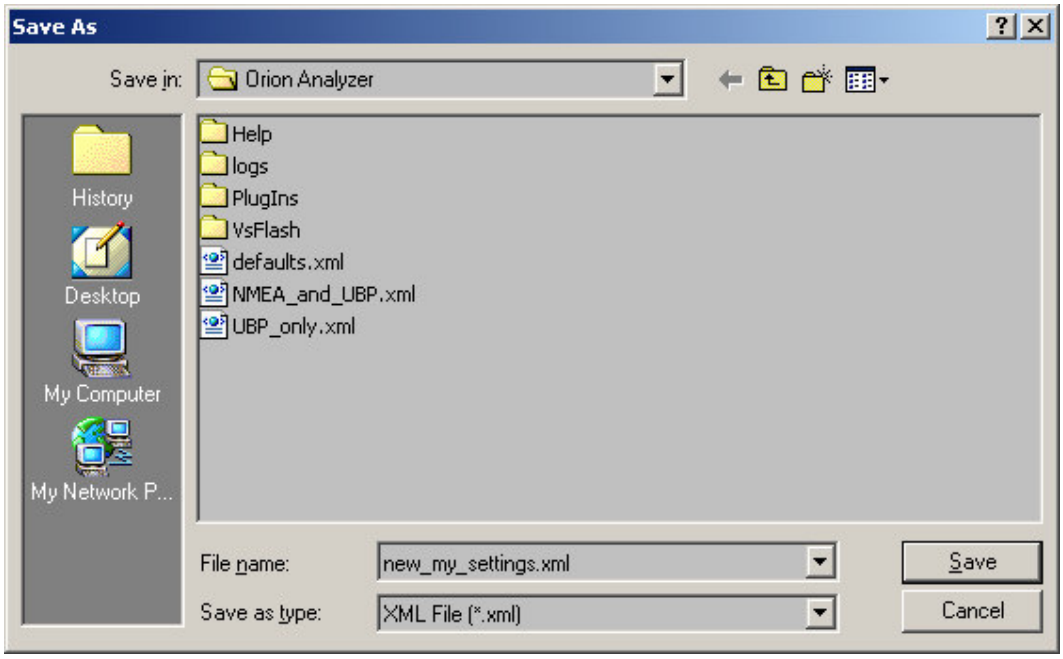
Orion Analyzer can work with different predefined work settings. For loading appropriate settings this menu item is used.

4.3.5 Save Settings…

"Save Settings" dialog can also be opened by pressing CTRL-S.

When used for the first time Orion Analyzer opens the default work settings (which are saved at defaults.xml file). During the work session the user can make modifications such as add additional receiver or open more views. To save working modifications this menu item is used.

4.3.6 Save Settings As…



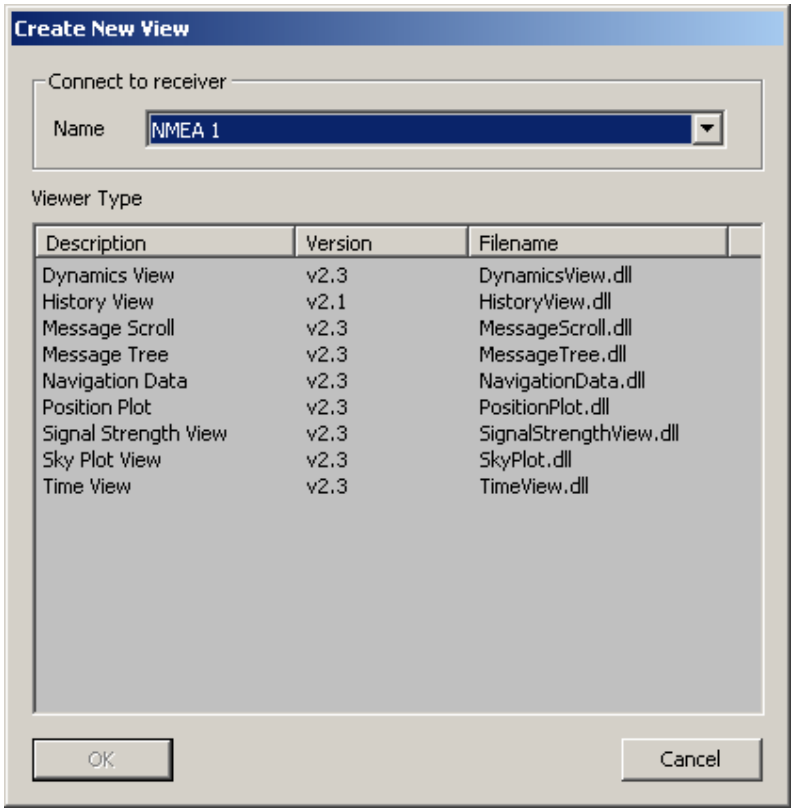
This menu item is used to save working settings in a new file.

4.4 Tools Menu

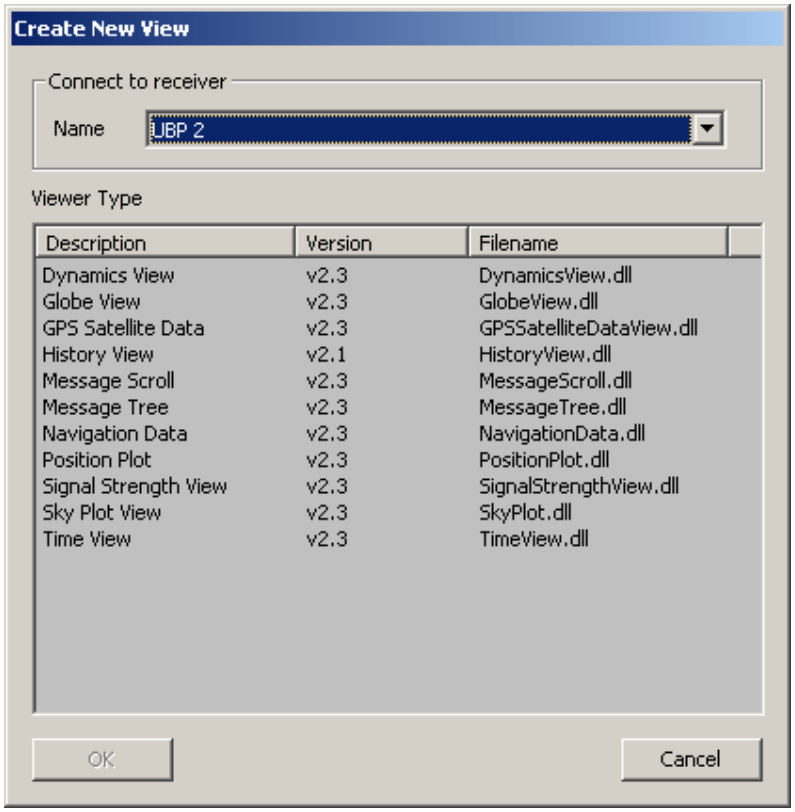
4.4.1 Open viewer(s)

“Open viewer(s)” dialog can also be opened by pressing CTRL-Shift-V or clicking on the

icon in the tool bar.



This dialog allows opening additional views for visualizing data. Different protocols have different amount of available views. The pictures above and below show the lists of available views for NMEA and UBP protocols, respectively.



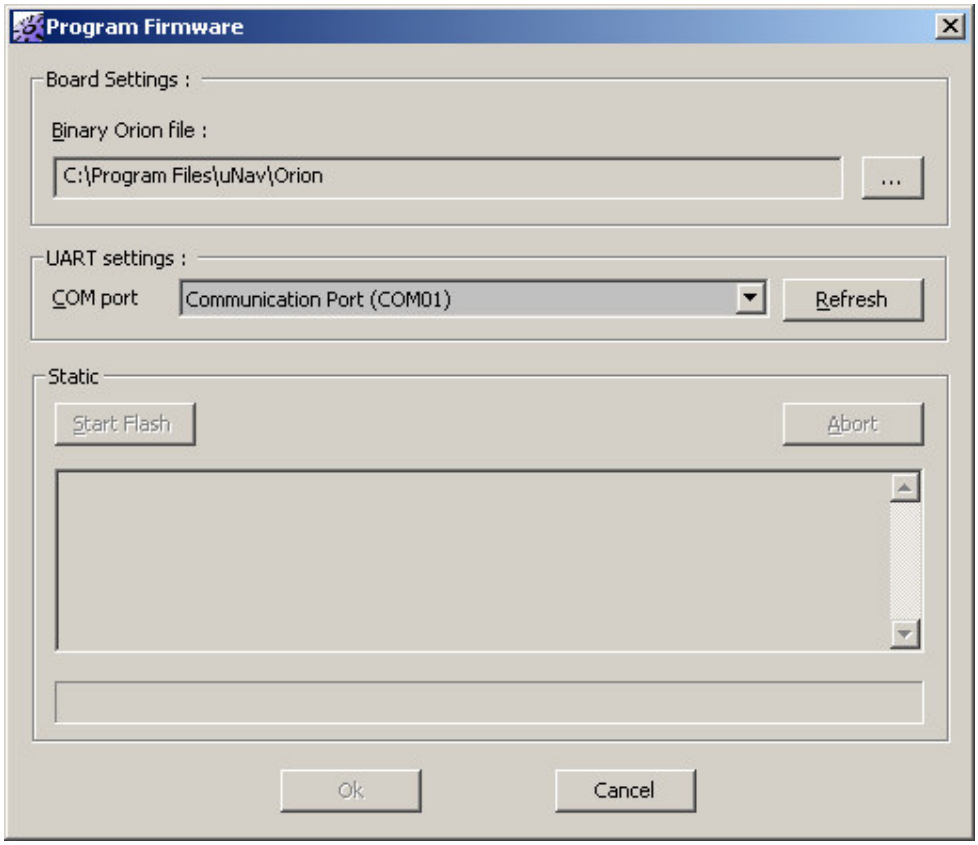
4.4.2 Program Firmware

"Program Firmware" dialog can also be opened by pressing CTRL-Shift-F or by clicking on the

icon in the tool bar.

To upload new Orion binary to the board this dialog is used. The path and binary file with COF extension have to be selected. After that an appropriate COM port has to be chosen and "Start Flash" button pressed.

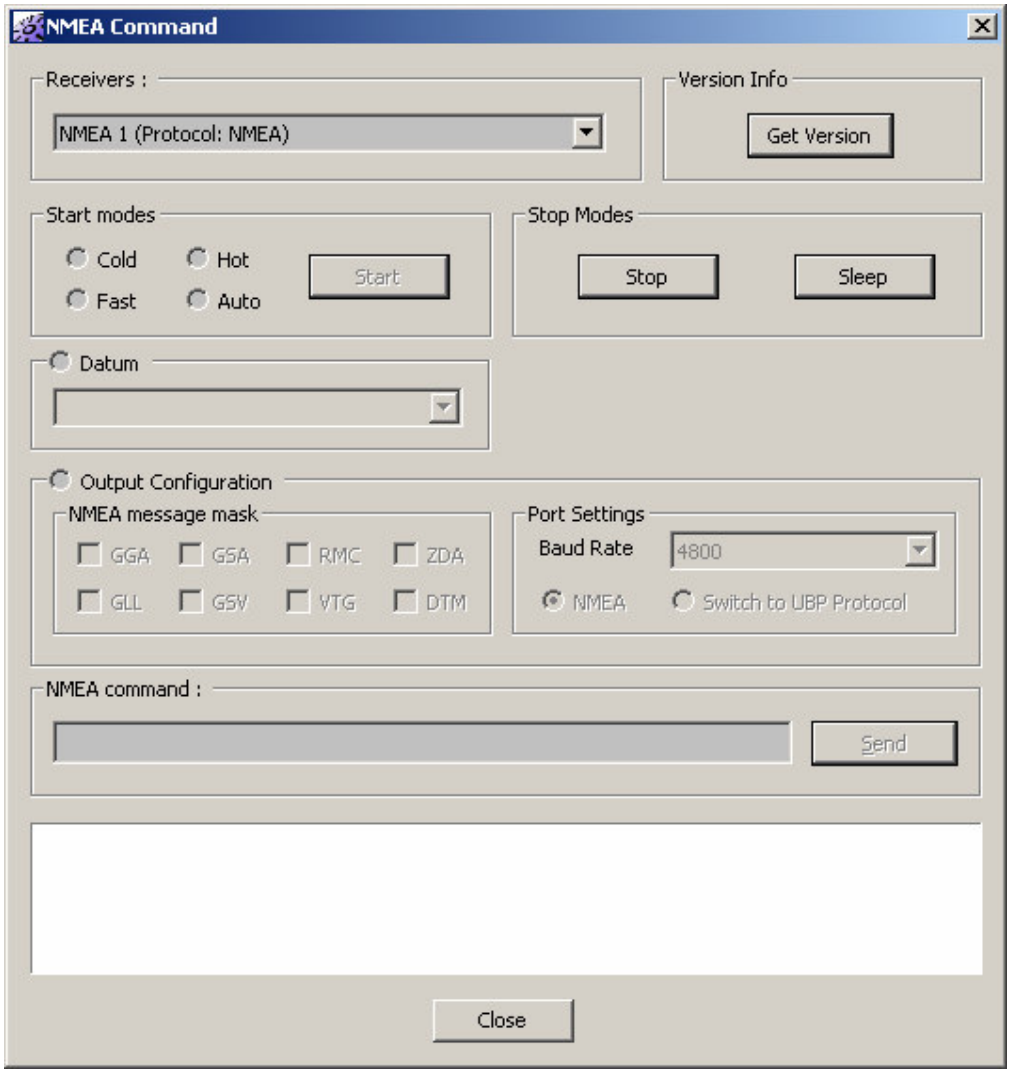
Note: If the selected COM port is already in use in the current session, it will be disconnected automatically before flashing operation and restored back after finishing.



4.4.3 NMEA Command

"NMEA Command" dialog can also be opened by pressing CTRL-Shift-N or by clicking on the

icon in the tool bar.

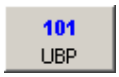


The dialog is used to handle the Orion through NMEA protocol. It allows getting version information, changing start and stop modes. It allows also changing output type messages and baud rate.

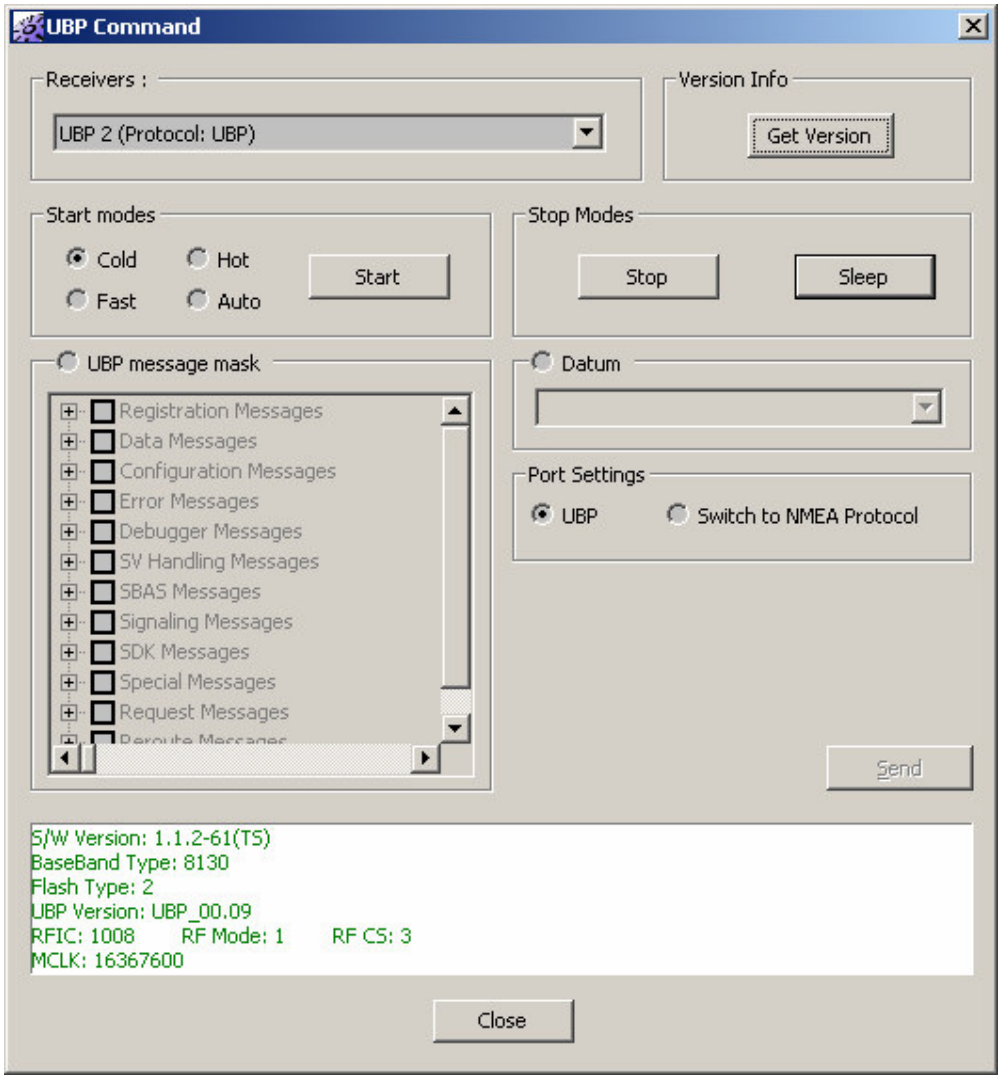
If the PC has only one COM port, this dialog allows switching from the NMEA protocol to the UBP protocol.

Note: The NMEA checksum is automatically added to the NMEA command.

4.4.4 UBP Command

"UBP Command" dialog can also be opened by pressing CTRL-Shift-U or by clicking on the 

icon in the tool bar.

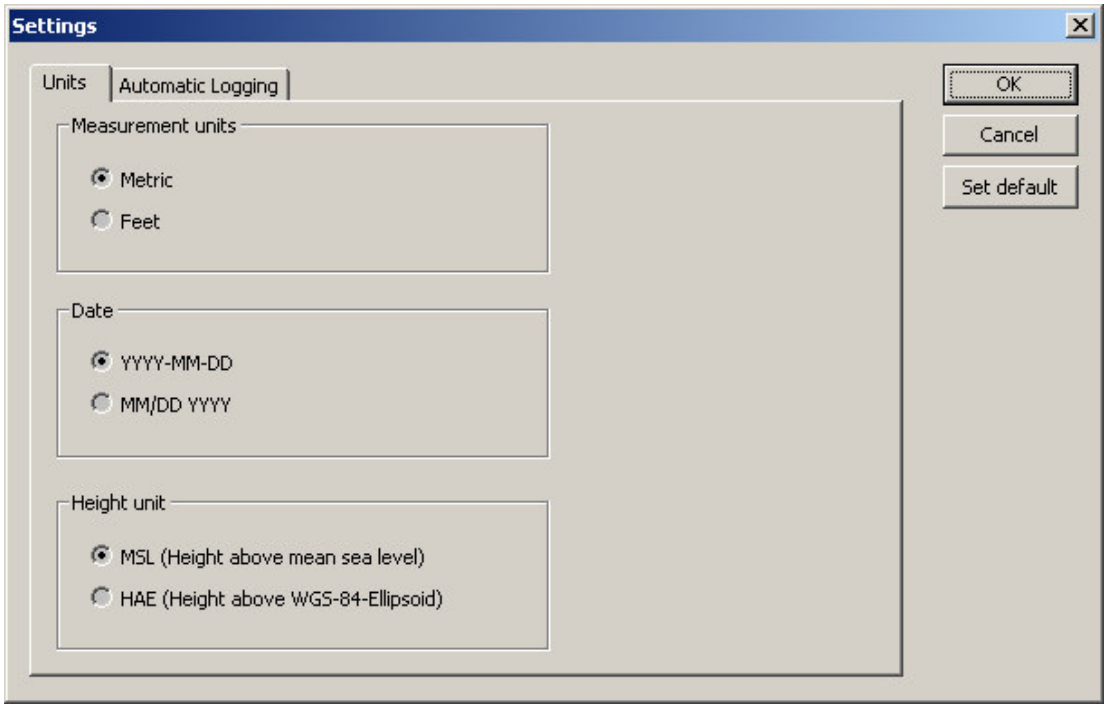


This dialog is used to handle the Orion through UBP protocol. It allows getting version information, changing start and stop modes. It allows also changing output type messages.

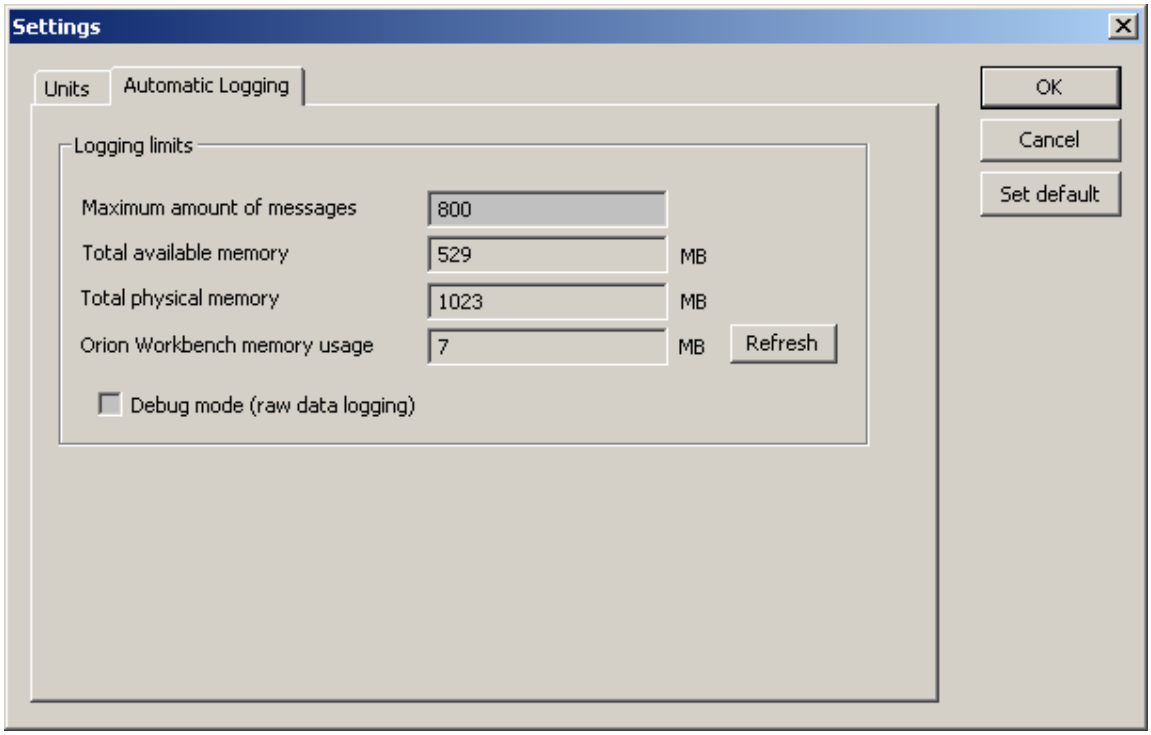
If the PC has got only one COM port, the dialog allows switching from UBP protocol to the NMEA protocol.

4.4.5 Settings

The dialog is used to set up global parameterswhich will be used during the session.



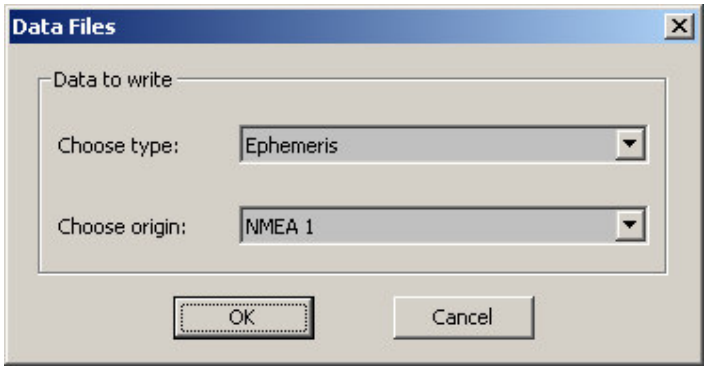
The units and date formats can be controlled with this dialog.



The automatic logging disk usage can be controlled with this dialog.

4.4.6 Data Files

The dialog allows exporting Ephemeris and/or Almanac data for UBP to the xml and txt formats.



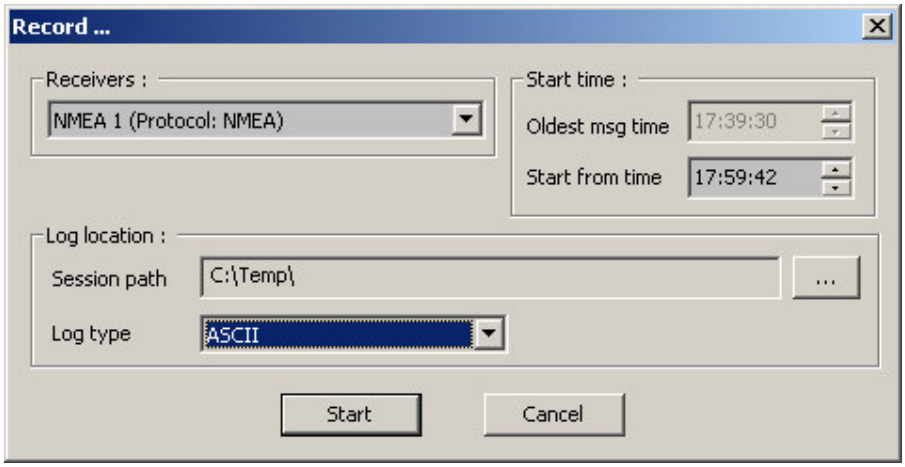
4.4.7 Record -> Start

"Record" dialog can also be opened by clicking on the

icon in the tool bar.

Once the connection is made, logging begins by selecting "Record". The dialog box is presented below; it prompts for the log file settings. Set the Session Path appropriately for your computer directory and select appropriate logging type.

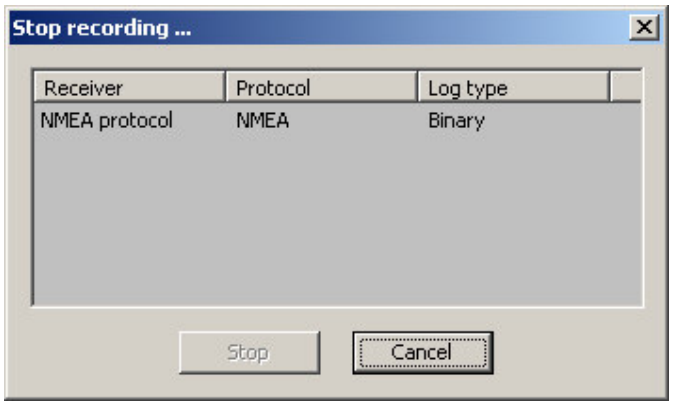
If UBP protocol is used, for best results, please use Log Type as Binary. When using multiple receivers, be sure to select the correct source – in this case only one COM port was used and this was NMEA 1.



4.4.8 Record -> Stop

"Stop Record" dialog can also be opened by clicking on the

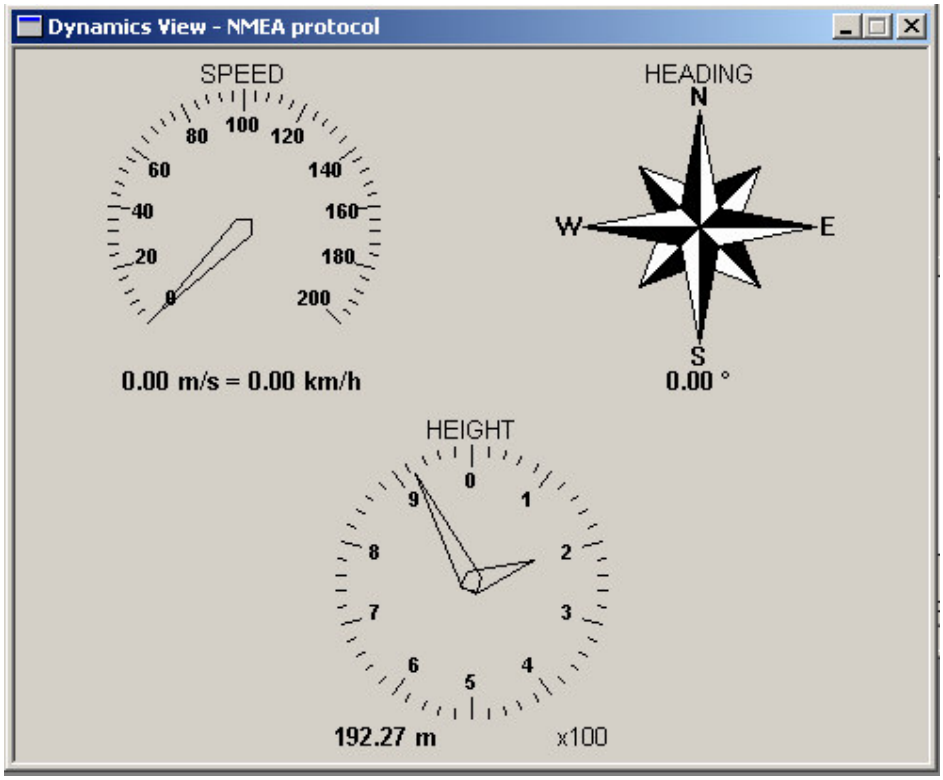
icon in the tool bar.



If recording operation is turned on, this dialog allows to stop recording. Orion Analyzer automatically stops recording before it is closed.

5 PLUG-INS

5.1 Dynamic View

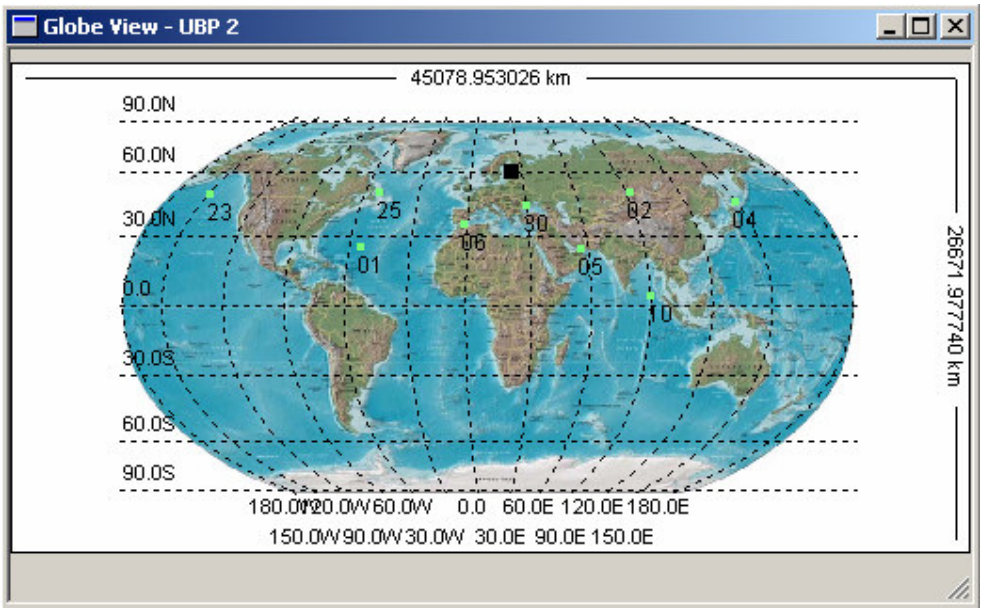


Dynamics view combines four different views inside one window. The views are “Horizontal speed”, “Vertical speed”, “Compass” and “Height”. UBP protocol supports all of these views and NMEA protocol doesn’t support “Vertical Speed” parameter. The data of these views is shown in both textual and a graphical format. Using context menu (mouse right click), the graphical mode can be switched to the text mode to make more window space is available. It is possible to hide one or more views to better make important views visible. These operations are available from the context menu.

The size of the window can be changed and the size graphical figures are resized accordingly. There are four adjustment modes: auto, side by side, one upon another and two rows. The adjustment mode and how many views are shown can be set to default in the context menu.

5.2 Globe View

Globe View plug-in is available only for UBP connection.

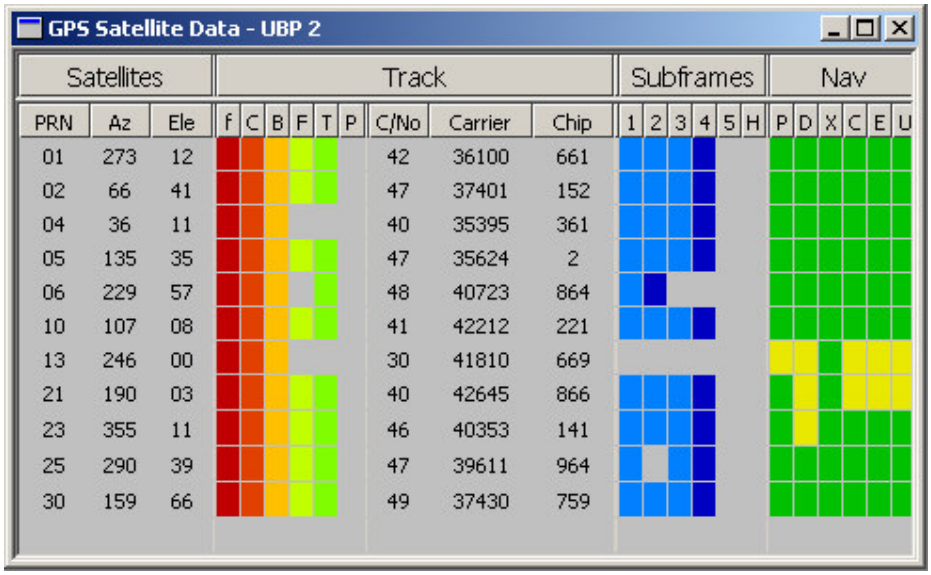


The Globe view shows the positions of all satellites around the world. Positions are based on position information of UBP messages (satellite info message). Every time a new position of satellite is received, it is updated to the view. It is possible to see all GPS satellite positions on the screen at the same time. Additionally SBAS satellites, WAAS and EGNOS, are shown with different color symbols.

The Globe view shows also the position of the navigation point on the world map. A more detailed look can be taken via the position plot.

5.3 GPS Satellite Data

GPS Satellite Data plug-in is available only for UBP connection.



GPS satellite data view is a grid view to show the basic information of available satellites. Only the information available is shown – otherwise the fields are empty.

The tracking bits are coded in the following way:

- f - Frequency lock
- C - code lock
- B - bit sync
- F - frame sync
- T - TOW decoded
- P - Parity error

Subframes (frame numbers) and H is health status.

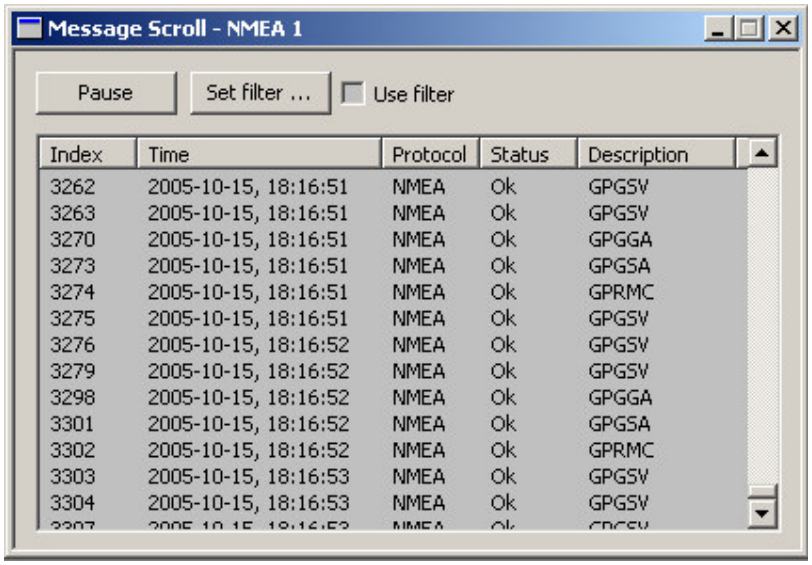
Nav Column bits mean:

- P - Pseudo range check
- D - Doppler check
- X - Cross correlation check
- C - C/N0 check
- E - Elevation check

- U - Used in solution

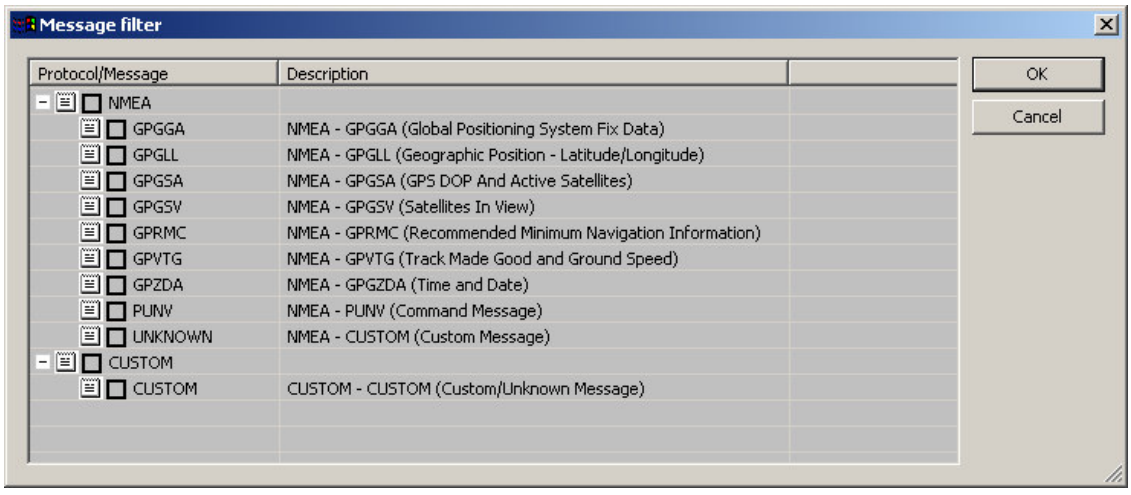
Dark blue color is used to indicate the current subframe in the Subframes section.

5.4 Message Scroll

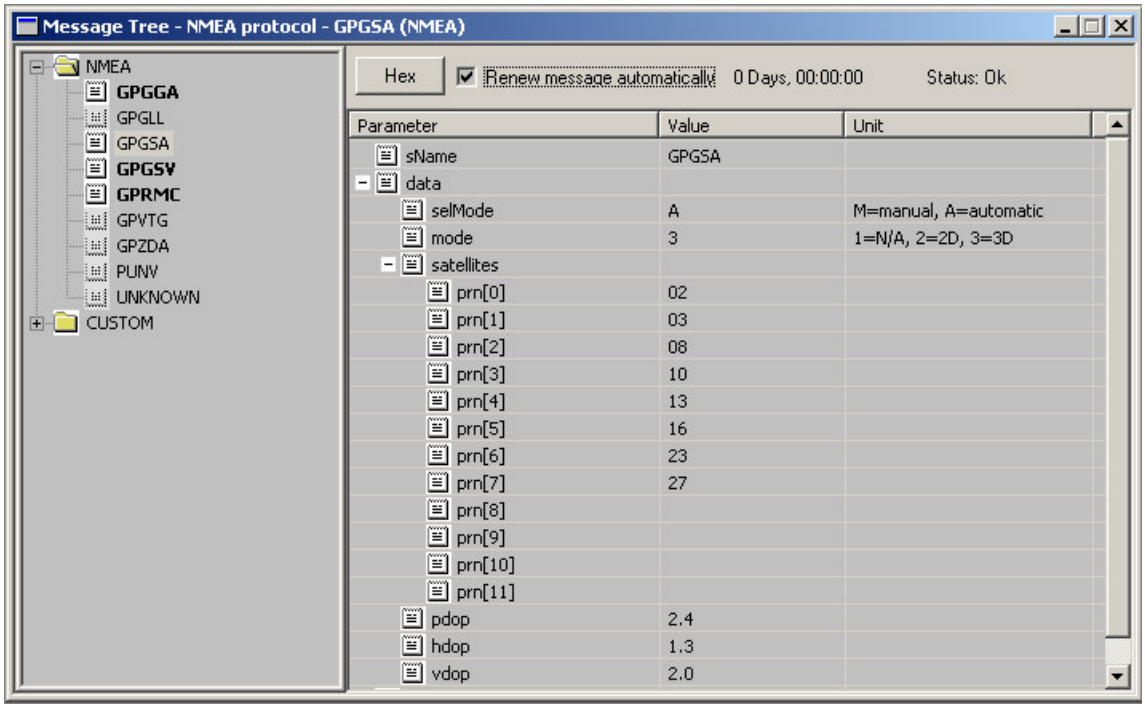


The message scroll view shows all received messages from one receiver. It shows the basic information of the message: receiving time, protocol and the message name. When the message row is double clicked, the message is opened to the message view for details of the message.

It is also possible to configure a filter for the messages. The user can select the message type depending on what messages are wanted to be seen.

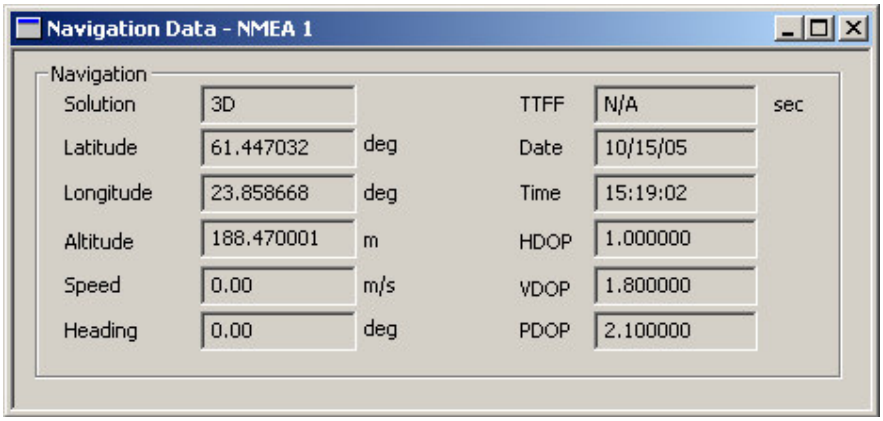

Message filter
Protocol/Message
Description
OK
Cancel
NMEA
GPGGA NMEA - GPGGA (Global Positioning System Fix Data)
GPGLL NMEA - GPGLL (Geographic Position - Latitude/Longitude)
GPGSA NMEA - GPGSA (GPS DOP And Active Satellites)
GPGSV NMEA - GPGSV (Satellites In View)
GPRMC NMEA - GPRMC (Recommended Minimum Navigation Information)
GPVTG NMEA - GPVTG (Track Made Good and Ground Speed)
GPZDA NMEA - GPGZDA (Time and Date)
PUNV NMEA - PUNV (Command Message)
UNKNOWN NMEA - CUSTOM (Custom Message)
CUSTOM
CUSTOM CUSTOM - CUSTOM (Custom/Unknown Message)

5.5 Message Tree

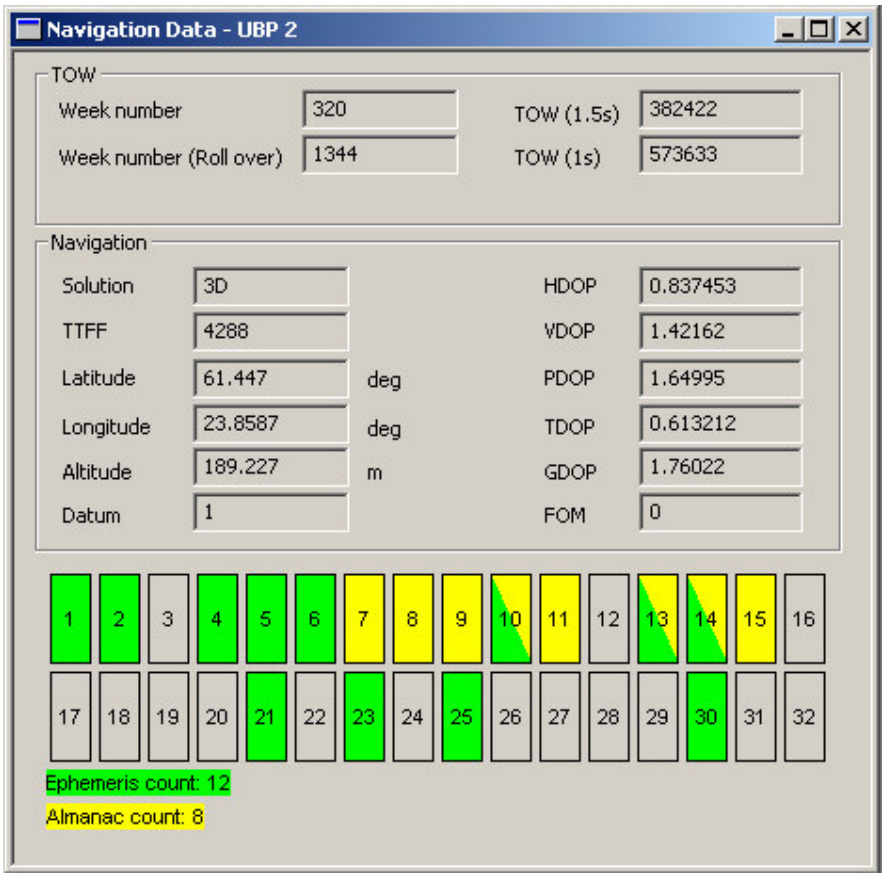


The message tree view shows the last instance of any received message type from one receiver. The user can see a tree view of all supported message types of each configured protocol. When a new message arrives, the appropriate message type name is bolded. When the user clicks with mouse the tree branch, the received message is opened to the right side of the tree view.

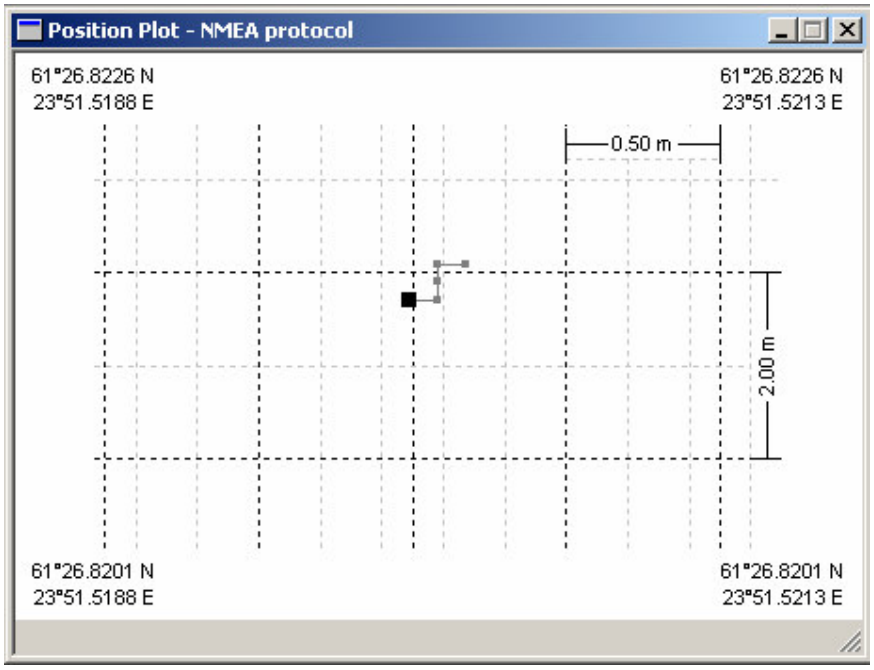
5.6 Navigation Data



Navigation data view is a text-based view that shows navigation related parameters. Different views are used for UBP and NMEA protocols. Parameters are read directly from data of received messages. For UBP protocol it indicates also whether the almanac or ephemeris information of each single satellite is available or received. It uses yellow color to indicate received almanac information, green color to indicate received ephemeris information and red color to indicate dead satellite. The dead satellite detection is determined from the received health data field of almanac or ephemeris.



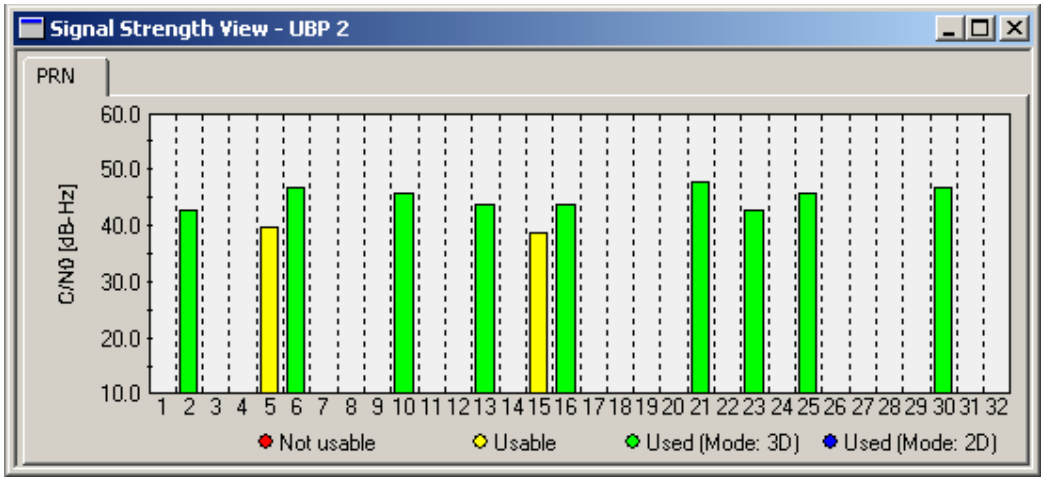
5.7 Position Plot



The Position Plot view shows the position of the fix on the plot. By default, the view shows grid lines. It is possible to follow up to 8 fix positions at the same time. The view can be configured to show history of fixes on the map. The length of the history and the color are configurable in context menu.

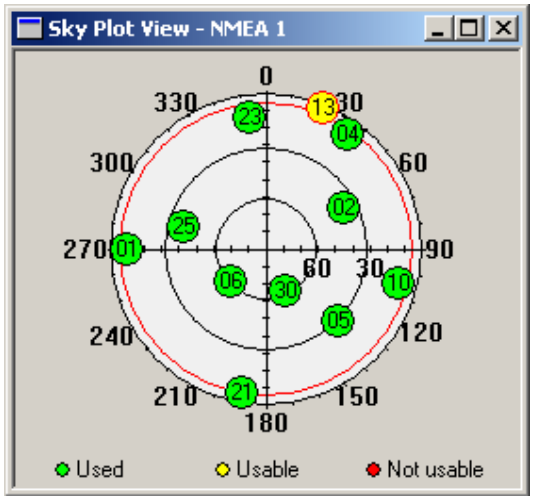
The view shows the whole world size grid by default. Auto panning and zooming are enabled right from the start. Immediately after the first received fix information, the grid is zoomed and scaled around the fix. The used grid scale is about 5 meters after the auto-zoom.

5.8 Signal Strength View



Signal strength view is a graphical view for the signal strengths (signal/noise) of satellites. The view can show all GPS satellites at the same time. Shown column may have three different states: “Not usable”, “Usable”, and “Used”. Used parameter is divided in two sections: 3D mode and 2D mode. State “Not usable” tells that the particular satellite is in such a location, that it cannot be used in navigation (bad angle or weak signal). Other states tell that the satellite could be used in navigation, but may not have been used. So the state “Used” tells that the satellite is used and “Usable” that it was not used in the positioning.

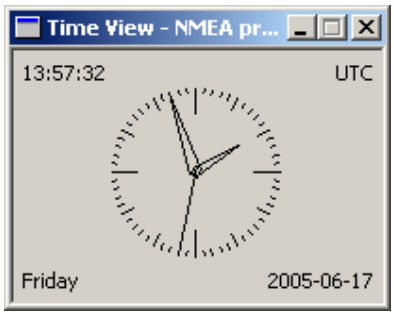
5.9 Sky Plot View



Sky Plot view is a graphical view for the positions of satellites, which are available for the place positioning. Each of them is shown immediately when the satellite position information is received. Shown satellite symbols may have three different states: “Not usable”, “Usable”, and “Used”. State “Not usable” tells that the particular satellite is in such a location that it cannot be used in navigation (bad angle or weak signal). Other states tell that the satellite could be used in navigation, but it may not have been used. So the state “Used” tells that the satellite is used and “Usable” that it was not used in the positioning.

Sky Plot shows satellites on the sky from the current place. Zero on the outer ring refers to North, with the other numbers referring to the direction (azimuth) measured in degrees. The distance from the center refers to the satellite elevation angle.

5.10 Time View



Time view is a very simple graphical view which shows the time of the received position fix. Every time a new position fix information is received, the received time stamp is shown on the view. It is possible to configure local time offset and the time is then shown as shifted by the given offset.